AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings of claims in the application:

LISTING OF CLAIMS:

1-73. (cancelled)

74. (currently amended) A method for determining filtering combinations of a spatial processing operation, the filtering combinations ($C_{l,m}^{l',m'}$) being applied to an initial sound field representation ($P_{l,m}^{(I)}$) formed by coefficients representative of the initial sound field in time and in the three spatial dimensions, in order to provide a modified sound field representation ($P_{l,m}^{(T)}$) formed by coefficients representative of that field in time and in the three spatial dimensions, the method comprising:

- defining (2) via a programmed computer processor the processing operation by a set of at least one directivity function,

- defining via a programmed processor a predetermined operation applied on the initial sound field representation and the set of at least one directivity function

- establishing (4) via a programmed computer processor spherical harmonic coefficients of each directivity function,

- determining via a programmed processor weighting coefficients (c) associated with the predetermined operation, and

- determining (6) via a programmed computer processor the filtering combinations from the spherical harmonic coefficients.

75. (previously presented) The method of claim 74, wherein the coefficients representative of the initial sound field and the coefficients representative of the modified sound field, are Fourier-Bessel coefficients.

76. (previously presented) The method of claim 75, further comprising specifying a parameter (L) representing the order limit of the Fourier-Bessel coefficients.

77. (canceled)

78. (previously presented) The method of claim 74, wherein the predetermined operation is the multiplication operation, for each direction, of the value of the directivity function of the initial sound field and the directivity function of the processing operation.

79. (previously presented) The method of claim 78, wherein the weighting coefficients of the multiplication operation, noted $c_{l,m,l'',m''}^{l',m'}$, are given by:

$$c_{l,m,l'',m''}^{l',m'} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(1)} + c_{l,-m,l'',m''}^{l',m'\,(1)}\right) & \text{for } m > 0 \\ c_{l,0,l'',m''}^{l',m'\,(1)} & \text{for } m = 0 \\ \frac{j}{\sqrt{2}}\left(c_{l,-m,l'',m''}^{l',m'\,(1)} - c_{l,m,l'',m''}^{l',m'\,(1)}\right) & \text{for } m < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(1)} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(2)} + c_{l,m,l'',-m''}^{l',m'\,(2)}\right) & \text{for } m'' > 0 \\ c_{l,m,l'',0}^{l',m'\,(2)} & \text{for } m'' = 0 \\ \frac{j}{\sqrt{2}}\left(c_{l,m,l'',-m''}^{l',m'\,(2)} - c_{l,m,l'',m''}^{l',m'\,(2)}\right) & \text{for } m'' < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(2)} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(3)} + c_{l,m,l'',m''}^{l',-m'\,(3)}\right) & \text{for } m' > 0 \\ c_{l,m,l'',m''}^{l',0\,(3)} & \text{for } m' = 0 \\ \frac{1}{j\sqrt{2}}\left(c_{l,m,l'',m''}^{l',-m'\,(3)} - c_{l,m,l'',m''}^{l',m'\,(3)}\right) & \text{for } m' < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(3)} = \delta_{m''}^{m'-m}\,\frac{1}{2\sqrt{\pi}}\,\frac{\sqrt{(2l+1)(2l'+1)(2l''+1)}}{l+l'+l''+1}\sqrt{\frac{\mathrm{C}_{l+|m|}^{l}\,\mathrm{C}_{l'+|m'|}^{l'}\,\mathrm{C}_{l''+|m''|}^{l''}}{\mathrm{C}_{l}^{|m|}\,\mathrm{C}_{l'}^{|m'|}\,\mathrm{C}_{l''}^{|m''|}}}\times$$
$$\sum_{k=|m|}^{l}\sum_{k'=|m'|}^{l'}\sum_{k''=|m''|}^{l''}(-1)^{k+k'+k''}\frac{\mathrm{C}_{l}^{k}\,\mathrm{C}_{l}^{k-|m|}\,\mathrm{C}_{l'}^{k'}\,\mathrm{C}_{l'}^{k'-|m'|}\,\mathrm{C}_{l''}^{k''}\,\mathrm{C}_{l''}^{k''-|m''|}}{\mathrm{C}_{l+l'+l''}^{k+k'+k''-n}}$$

and

$$\delta_x^y = \begin{cases} 1 & \text{for } x = y \\ 0 & \text{for } x \neq y \end{cases}$$

and

$$n = \frac{|m|+|m'|+|m''|}{2}$$

and

$$C_n^p = \frac{n!}{p!\,(n-p)!}.$$

80. (previously presented) The method of claim 74, wherein the predetermined operation is the convolution operation, for each direction, of the value of the directivity function of the initial sound field and the directivity function of the processing operation.

81. (previously presented) The method of claim 78, wherein the weighting coefficients of the convolution operation, noted $c_{l,m,l'',m''}^{l',m'}$, are given by:

$$c_{l,m,l'',m''}^{l',m'} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(1)} + c_{l,-m,l'',m''}^{l',m'\,(1)}\right) & \text{for } m > 0 \\ c_{l,0,l'',m''}^{l',m'\,(1)} & \text{for } m = 0 \\ \frac{j}{\sqrt{2}}\left(c_{l,-m,l'',m''}^{l',m'\,(1)} - c_{l,m,l'',m''}^{l',m'\,(1)}\right) & \text{for } m < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(1)} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(2)} + c_{l,m,l'',-m''}^{l',m'\,(2)}\right) & \text{for } m'' > 0 \\ c_{l,m,l'',0}^{l',m'\,(2)} & \text{for } m'' = 0 \\ \frac{j}{\sqrt{2}}\left(c_{l,m,l'',-m''}^{l',m'\,(2)} - c_{l,m,l'',m''}^{l',m'\,(2)}\right) & \text{for } m'' < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(2)} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(3)} + c_{l,m,l'',m''}^{l',-m'\,(3)}\right) & \text{for } m' > 0 \\ c_{l,m,l'',m''}^{l',0\,(3)} & \text{for } m' = 0 \\ \frac{1}{j\sqrt{2}}\left(c_{l,m,l'',m''}^{l',-m'\,(3)} - c_{l,m,l'',m''}^{l',m'\,(3)}\right) & \text{for } m' < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(3)} = \delta_{l''}^{l}\,\delta_{m''}^{m'-m}\,2\sqrt{\pi}\,\varepsilon_{m'}^{m'}\,\varepsilon_{m''}^{m''}\frac{\sqrt{2l+1}}{l'+l+1}\sqrt{\frac{\mathrm{C}_{l+|m|}^{l}\,\mathrm{C}_{l'+|m'|}^{l'}\,\mathrm{C}_{l'}^{|m''|}}{\mathrm{C}_{l}^{|m|}\,\mathrm{C}_{l'}^{|m'|}\,\mathrm{C}_{l'+|m''|}^{l'}}}\sum_{k=|m|}^{l}\mathrm{C}_{l}^{k}\,\mathrm{C}_{l}^{k-|m|}\times$$

$$\sum_{p=\max(0,-m)}^{\min(l'-m',l'+m'')}(-1)^{p+k+m}\,\mathrm{C}_{l'+m''}^{p}\,\mathrm{C}_{l'-m''}^{p+m}\times\begin{cases}1/\mathrm{C}_{l'+l}^{p+k} & \text{if } m\geq 0\\ 1/\mathrm{C}_{l'+l}^{p+k+m} & \text{if } m\leq 0\end{cases}$$

and

$$\varepsilon_{m}^{m} = \big(\mathrm{sign}(m)\big)^{m}.$$

82. (previously presented) The method according to claim 74,

wherein the processing operation is a distortion,

wherein the set of at least one directivity function comprises N pairs of directivity functions which form a set of distortion pairs representative of the distortion, and

wherein the filtering combinations are determined from the spherical harmonic coefficients of the N pairs of directivity functions.

83. (currently amended) A method for applying a spatial processing operation to an initial sound field, the method comprising:

- establishing an initial sound field representation formed by coefficients representative of the initial sound field in time and in the three spatial dimensions,

- determining filtering combinations of the processing operation, according to the method of claim 74, and

- applying the filtering combinations to the initial sound field representation,

wherein at least one processing operation is a rotation operation,

the method further comprising:

- determining the filtering combinations of the rotation operation according to the parameters (θ, ϕ, ψ) representative of the rotation, according to:

$$C_{l,m}^{l',m'} = \delta_l^{l'} \, D_{m',m}^{l\,R}$$

with

$$D_{m',m}^{l\,R} = \begin{cases} \Re(D_{m',m}^{l} + D_{-m',m}^{l}) & \text{if } m' > 0 \text{ and } m > 0 \\ \sqrt{2}\,\Re(D_{m',0}^{l}) & \text{if } m' > 0 \text{ and } m = 0 \\ \Im(D_{m',m}^{l} + D_{-m',m}^{l}) & \text{if } m' > 0 \text{ and } m < 0 \\ \sqrt{2}\,\Re(D_{0,m}^{l}) & \text{if } m' = 0 \text{ and } m > 0 \\ D_{0,0}^{l} & \text{if } m' = 0 \text{ and } m = 0 \\ \sqrt{2}\,\Im(D_{0,m}^{l}) & \text{if } m' = 0 \text{ and } m < 0 \\ \Im(D_{-m',m}^{l} - D_{m',m}^{l}) & \text{if } m' < 0 \text{ and } m > 0 \\ -\sqrt{2}\,\Im(D_{m',0}^{l}) & \text{if } m' < 0 \text{ and } m = 0 \\ \Re(D_{m',m}^{l} - D_{-m',m}^{l}) & \text{if } m' < 0 \text{ and } m < 0 \end{cases}$$

with

$$D_{m',m}^{l} = \varepsilon_m^m \, \varepsilon_{m'}^{m'} \, d_{m',m}^{l}(\theta) \, e^{-jm'\phi} \, e^{-jm\psi}$$

with

$$d^{l}_{m',m}(\theta) = \sqrt{\frac{(l+m')!\,(l-m')!}{(l+m)!\,(l-m)!}} \sum_{k=\max(0,m-m')}^{\min(l-m',l+m)} (-1)^k\, \mathrm{C}^{k}_{l+m}\, \mathrm{C}^{k+m'-m}_{l-m} \times \left(\cos\frac{\theta}{2}\right)^{2l+m-m'-2k} \left(\sin\frac{\theta}{2}\right)^{2k+m'-m}$$

and

$\Re(x) = \text{real part}(x)$

and

$\Im(x) = \text{imaginary part}(x)$.

84. (currently amended) A method for applying a combination of spatial processing operations to an initial sound field, the method comprising:

- establishing an initial sound field representation formed by coefficients representative of the initial sound field in time and in the three spatial dimensions,

- determining filtering combinations of each processing operation, the filtering combinations being applied to the initial sound field representation, in order to provide a modified sound field representation formed by coefficients representative of that field in time and in the three spatial dimensions, wherein the filtering combinations of at least one processing operation is achieved by the method of claim 74,

- determining overall filtering combinations by combining the filtering combinations of each processing operation, and

- applying the overall filtering combinations to the initial sound field representation,

wherein at least one processing operation is a rotation operation,

the method further comprising:

- determining the filtering combinations of the rotation operation according to the parameters (θ,ϕ,ψ) representative of the rotation, according to:

$$C_{l,m}^{l',m'} = \delta_l^{l'}\, D_{m',m}^{l\,R}$$

with

$$D_{m',m}^{l\,R} = \begin{cases} \Re(D_{m',m}^{l} + D_{-m',m}^{l}) & \text{if } m'>0 \text{ and } m>0 \\ \sqrt{2}\,\Re(D_{m',0}^{l}) & \text{if } m'>0 \text{ and } m=0 \\ \Im(D_{m',m}^{l} + D_{-m',m}^{l}) & \text{if } m'>0 \text{ and } m<0 \\ \sqrt{2}\,\Re(D_{0,m}^{l}) & \text{if } m'=0 \text{ and } m>0 \\ D_{0,0}^{l} & \text{if } m'=0 \text{ and } m=0 \\ \sqrt{2}\,\Im(D_{0,m}^{l}) & \text{if } m'=0 \text{ and } m<0 \\ \Im(D_{-m',m}^{l} - D_{m',m}^{l}) & \text{if } m'<0 \text{ and } m>0 \\ -\sqrt{2}\,\Im(D_{m',0}^{l}) & \text{if } m'<0 \text{ and } m=0 \\ \Re(D_{m',m}^{l} - D_{-m',m}^{l}) & \text{if } m'<0 \text{ and } m<0 \end{cases}$$

with

$$D_{m',m}^{l} = \varepsilon_m^m\, \varepsilon_{m'}^{m'}\, d_{m',m}^{l}(\theta)\, e^{-jm'\phi}\, e^{-jm\psi}$$

with

$$d^{l}_{m',m}(\theta) = \sqrt{\frac{(l+m')!\,(l-m')!}{(l+m)!\,(l-m)!}} \sum_{k=\max(0,m-m')}^{\min(l-m',l+m)} (-1)^k\, \mathrm{C}^{k}_{l+m}\, \mathrm{C}^{k+m'-m}_{l-m} \times \left(\cos\frac{\theta}{2}\right)^{2l+m-m'-2k} \left(\sin\frac{\theta}{2}\right)^{2k+m'-m}$$

and

$\Re(x) = \text{real part}(x)$

and

$\Im(x) = \text{imaginary part}(x)$.

85. (canceled)

86. (currently amended) A device for determining filtering combinations of a spatial processing operation, the filtering combinations ($C^{l',m'}_{l,m}$) being applied to an initial sound field representation ($P^{(I)}_{l,m}$) formed by coefficients representative of the initial sound field in time and in the three spatial dimensions, in order to provide a modified sound field representation ($P^{(T)}_{l,m}$) formed by coefficients representative of that field in time and in the three spatial dimensions, the device comprising:

a processor programmed to include:

- means for defining the processing operation by a set of at least one directivity function,

- means for defining a predetermined operation applied on the initial sound field representation and the set of at least one directivity function,

- means for establishing spherical harmonic coefficients of each directivity function,

- means for determining weighting coefficients (c) associated with the predetermined operation, and

- means for determining the filtering combinations from the spherical harmonic coefficients.

87. (previously presented) The device of claim 86, wherein the coefficients representative of the initial sound field and the coefficients representative of the modified sound field, are Fourier-Bessel coefficients.

88. (previously presented) The device of claim 87, further comprising means for specifying a parameter (L) representing the order limit of the Fourier-Bessel coefficients.

89. (canceled)

90. (previously presented) The device of claim 86, wherein the predetermined operation is the multiplication operation, for each direction, of the value of the directivity function of the initial sound field and the directivity function of the processing operation.

91. (previously presented) The device of claim 90, wherein the weighting coefficients of the multiplication operation, noted $c_{l,m,l'',m''}^{l',m'}$, are given by:

$$c_{l,m,l'',m''}^{l',m'} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(1)} + c_{l,-m,l'',m''}^{l',m'\,(1)}\right) & \text{for } m > 0 \\ c_{l,0,l'',m''}^{l',m'\,(1)} & \text{for } m = 0 \\ \frac{j}{\sqrt{2}}\left(c_{l,-m,l'',m''}^{l',m'\,(1)} - c_{l,m,l'',m''}^{l',m'\,(1)}\right) & \text{for } m < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(1)} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(2)} + c_{l,m,l'',-m''}^{l',m'\,(2)}\right) & \text{for } m'' > 0 \\ c_{l,m,l'',0}^{l',m'\,(2)} & \text{for } m'' = 0 \\ \frac{j}{\sqrt{2}}\left(c_{l,m,l'',-m''}^{l',m'\,(2)} - c_{l,m,l'',m''}^{l',m'\,(2)}\right) & \text{for } m'' < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(2)} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(3)} + c_{l,m,l'',m''}^{l',-m'\,(3)}\right) & \text{for } m' > 0 \\ c_{l,m,l'',m''}^{l',0\,(3)} & \text{for } m' = 0 \\ \frac{1}{j\sqrt{2}}\left(c_{l,m,l'',m''}^{l',-m'\,(3)} - c_{l,m,l'',m''}^{l',m'\,(3)}\right) & \text{for } m' < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(3)} = \delta_{m''}^{m'-m} \frac{1}{2\sqrt{\pi}} \frac{\sqrt{(2l+1)(2l'+1)(2l''+1)}}{l+l'+l''+1} \sqrt{\frac{\mathrm{C}_{l+|m|}^{l}\,\mathrm{C}_{l'+|m'|}^{l'}\,\mathrm{C}_{l''+|m''|}^{l''}}{\mathrm{C}_{l}^{|m|}\,\mathrm{C}_{l'}^{|m'|}\,\mathrm{C}_{l''}^{|m''|}}} \times \sum_{k=|m|}^{l} \sum_{k'=|m'|}^{l'} \sum_{k''=|m''|}^{l''} (-1)^{k+k'+k''} \frac{\mathrm{C}_{l}^{k}\,\mathrm{C}_{l}^{k-|m|}\,\mathrm{C}_{l'}^{k'}\,\mathrm{C}_{l'}^{k'-|m'|}\,\mathrm{C}_{l''}^{k''}\,\mathrm{C}_{l''}^{k''-|m''|}}{\mathrm{C}_{l+l'+l''}^{k+k'+k''-n}}$$

and

$$\delta_x^y = \begin{cases} 1 & \text{for } x = y \\ 0 & \text{for } x \neq y \end{cases}$$

and

$$n = \frac{|m| + |m'| + |m''|}{2}$$

and

$$C_n^p = \frac{n!}{p!\,(n-p)!}.$$

92. (previously presented) The device of claim 86, wherein the predetermined operation is the convolution operation, for each direction, of the value of the directivity function of the initial sound field and the directivity function of the processing operation.

93. (previously presented) The device of claim 92, wherein the weighting coefficients of the convolution operation, noted $c_{l,m,l'',m''}^{l',m'}$, are given by:

$$c_{l,m,l'',m''}^{l',m'} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(1)} + c_{l,-m,l'',m''}^{l',m'\,(1)}\right) & \text{for } m > 0 \\ c_{l,0,l'',m''}^{l',m'\,(1)} & \text{for } m = 0 \\ \frac{j}{\sqrt{2}}\left(c_{l,-m,l'',m''}^{l',m'\,(1)} - c_{l,m,l'',m''}^{l',m'\,(1)}\right) & \text{for } m < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(1)} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(2)} + c_{l,m,l'',-m''}^{l',m'\,(2)}\right) & \text{for } m'' > 0 \\ c_{l,m,l'',0}^{l',m'\,(2)} & \text{for } m'' = 0 \\ \frac{j}{\sqrt{2}}\left(c_{l,m,l'',-m''}^{l',m'\,(2)} - c_{l,m,l'',m''}^{l',m'\,(2)}\right) & \text{for } m'' < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(2)} = \begin{cases} \frac{1}{\sqrt{2}}\left(c_{l,m,l'',m''}^{l',m'\,(3)} + c_{l,m,l'',m''}^{l',-m'\,(3)}\right) & \text{for } m' > 0 \\ c_{l,m,l'',m''}^{l',0\,(3)} & \text{for } m' = 0 \\ \frac{1}{j\sqrt{2}}\left(c_{l,m,l'',m''}^{l',-m'\,(3)} - c_{l,m,l'',m''}^{l',m'\,(3)}\right) & \text{for } m' < 0 \end{cases}$$

with

$$c_{l,m,l'',m''}^{l',m'\,(3)} = \delta_{l''}^{l}\,\delta_{m''}^{m'-m}\,2\sqrt{\pi}\,\varepsilon_{m'}^{m'}\,\varepsilon_{m''}^{m''}\frac{\sqrt{2l+1}}{l'+l+1}\sqrt{\frac{\mathrm{C}_{l+|m|}^{l}\,\mathrm{C}_{l'+|m'|}^{l'}\,\mathrm{C}_{l'}^{|m''|}}{\mathrm{C}_{l}^{|m|}\,\mathrm{C}_{l'}^{|m'|}\,\mathrm{C}_{l'+|m''|}^{l'}}}\sum_{k=|m|}^{l}\mathrm{C}_{l}^{k}\,\mathrm{C}_{l}^{k-|m|}\times$$
$$\sum_{p=\max(0,-m)}^{\min(l'-m',l'+m'')}(-1)^{p+k+m}\,\mathrm{C}_{l'+m''}^{p}\,\mathrm{C}_{l'-m''}^{p+m}\times\begin{cases} 1/\mathrm{C}_{l'+l}^{p+k} & \text{if } m \geq 0 \\ 1/\mathrm{C}_{l'+l}^{p+k+m} & \text{if } m \leq 0 \end{cases}$$

and

$$\varepsilon_{m}^{m} = \left(\mathrm{sign}(m)\right)^{m}.$$

94. (previously presented) The device according to claim 86,

wherein the processing operation is a distortion,

wherein the set of at least one directivity function comprises N pairs of directivity functions which form a set of distortion pairs representative of the distortion, and

wherein the filtering combinations are determined from the spherical harmonic coefficients of the N pairs of directivity functions.